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## **A Portable ECG Recorder for Shipboard Use**

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A portable, 12-channel electrocardiogram (ECG) recorder is described. It weighs approximately 11 pounds, can be battery operated, and provides interpretation of the ECG tracing and a computer interface. It can be used in isolated environments, emergency vehicles, or a physician's office.

It is difficult to provide high quality medical care in isolated environments. Limited facilities and the absence of laboratories and consultants present a challenge to the most experienced practitioner. The challenge is magnified when the provider is not a physician. The computer, with its ability to store large amounts of medical information, can assist in the improvement of medical care.

In 1976, the Naval Submarine Medical Research Laboratory (NSMRL), Groton, CT, initiated the development of an interactive computer-based medical diagnostic/information system (MEDIC) which would serve as a medical consultant to the Independent Duty Corpsman.<sup>1</sup> MEDIC, a complete patient management system, utilizing "artificial intelligence algorithms," provides the practitioner with diagnostic, prognostic, and treatment guides for abdominal pain, chest pain, psychiatric disorders, dental disorders, and emergency medical conditions.

The system was designed for use on submarines where such common tools as x-rays and electrocardiograms (ECG) are not available. In the absence of such tools and of communication

with other medical facilities for extended periods of time, the submarine hospital corpsman, the sole medical practitioner on board, must provide medical care for 100 to 170 men. He must decide whether an illness can be treated on board or requires evacuation. Evacuation can endanger the lives of both the patient and the rescue party, and it is expensive. The same may also be true for surface vessels and isolated outposts.

During the development of the chest pain diagnostic program, it became clear that ECG data would improve the accuracy of diagnosis of a myocardial event and improve the corpsman's ability to treat such patients. Existing ECG recorders were too large to be used aboard submarines and lacked transmission capability. After evaluating many ECG systems, Marquette Electronics, the supplier of the MAC-II ECG recorder being used as part of the Tri-Service Medical Information System's (TRIMIS) Computer Assisted Processing of Cardiograms (CAPOC) program, was asked to develop a small portable ECG machine which could provide data for input to the MEDIC system. To meet this requirement, Marquette extensively redesigned their standard MAC-II recorder, and in November 1985 delivered a 12 x 8 x 4 inch recorder which weighed about 12 pounds (Fig. 1). The following characteristics were provided:

Simultaneous acquisition and analysis of all 12 classical leads.

Incorporation of the Marquette 12SL Analysis Program. ECG tracings printed in three sequential strips containing the full interpretation produced by the recorder. (See Fig. 2). Capability of transmitting ECG tracings to CAPOC system by plugging in a telephone modem.

Operate from an internal rechargeable battery or 120 VAC. Size is 12 x 8 x 4 inches.

Can store up to 50 ECG tracings.

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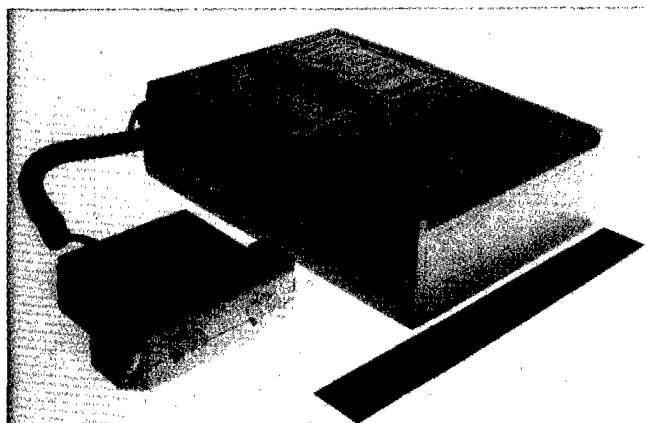


Fig. 1. Portable MAC-PC ECG machine by Marquette.

While tests of the system are still being conducted, studies indicate that the portable ECG, called the MAC-PC, performs as well as, and does everything that can be done with the

original, larger, MAC-II. Figure 2 shows the ECG strips together with the interpretive data which are obtained from this device.

The MAC-PC has been received with enthusiasm by members of the medical community who have seen the unit. Twelve recorders are presently available and have been loaned at various times to various submarines for testing. Feedback from the submarine community has been quite favorable. Testing of this device continues. In addition to the uses intended for it by the Navy, the MAC-PC can be used in such places as ambulances, emergency medical vehicles, and physician's offices. Because of its design, the ECGs are readily interpretable by a paramedic or emergency medical technician. Furthermore, its transmission capability enables ECG information to be relayed to a receiving center prior to a patient's arrival.

### References

1. Ryack BL: A Computer-Based Diagnostic/Information Patient Management System for Isolated Environments: MEDIC Ten Years Later. NAV-SUBMEDRSCHLAB Report No 1089, 1987

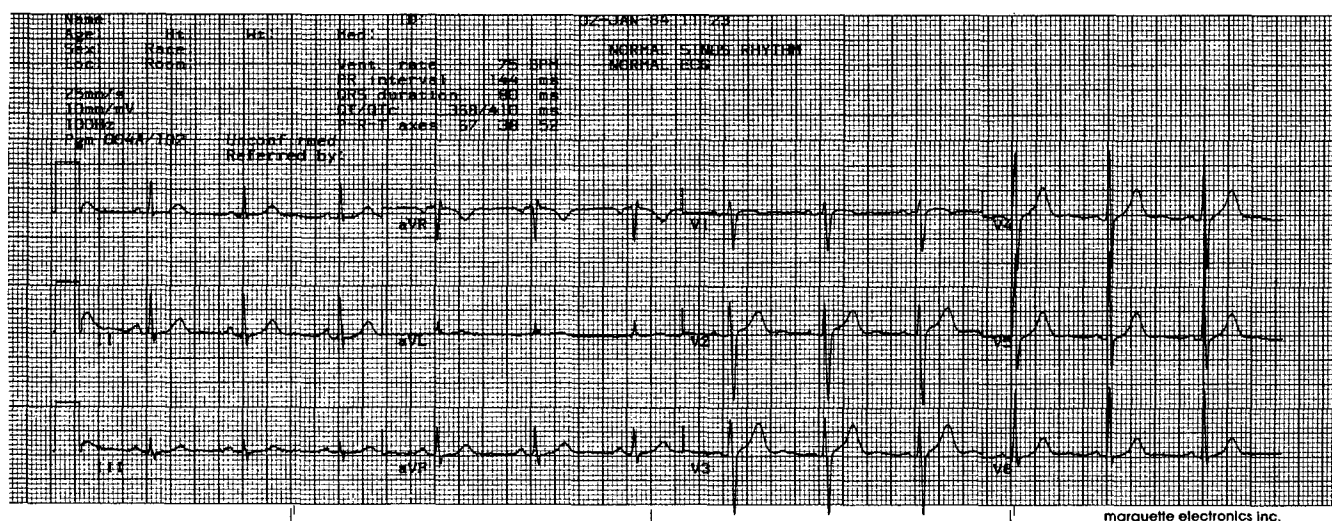


Fig. 2. Sample tracing from portable ECG. Diagnosis is for normal sinus rhythm.